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## What If Virus Lockdowns Targeted People Based on Vulnerability?

An age-based, targeted policy of lockdowns could substantially reduce the economic cost of pandemic response, according to research reported in **A Multi-Risk SIR Model with Optimally Targeted Lockdown** (NBER Working Paper 27102). Daron Acemoglu, Victor Chernozhukov, Iván Werning, and Michael D. Whinston formulate a model of disease spread and conclude that varying restrictions on personal mobility in the COVID-19 pandemic across various groups depending on their vulnerability to the virus could lower the economic cost of these restrictions. The researchers estimate that a semi-targeted approach that isolates only seniors could reduce the economic loss by half, relative to a uniform lockdown policy, while also reducing the number of lives lost.

To compare broad-based and targeted lockdown models, the researchers develop a simulation model that is calibrated to capture broad features of the COVID-19 pandemic, the macroeconomy, and the interactions between the two. The model illustrates key trade-offs, but is not designed to precisely match data from the United States or any other nation.

The researchers adopt a Susceptible-Infectious-

Recovered (SIR) modeling structure in which those who fall ill and recover become immune to the disease, leading to a decline in the susceptible population. They divide the adult population into three groups: young, ages 20–49;

middle-aged, 50–64; and old, 65 and over. The 65-and-over group has 20 percent of the earnings of the younger groups and, crucially, faces a much higher mortality rate from COVID-19. The average mortality rate given infection rises from 0.001 percent for the youngest

group, to 0.01 for the middle aged, to 0.06 for seniors. The study assumes that a vaccine will be fully available within a year and a half.

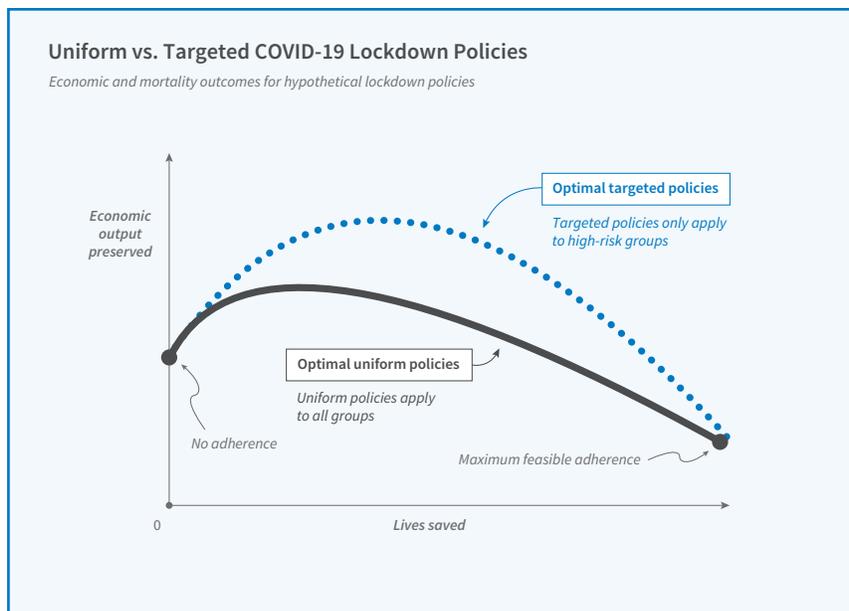
The researchers perform a stylized calculation designed to trade off the benefit of sav-

Simulations suggest substantial reductions in the economic cost of pandemic response from targeting seniors for restrictions on personal mobility and interpersonal interactions.

ing lives and the economic cost of a shutdown. With uniform policies, the options available to policymakers are grim. An optimal policy keeping adult mortality to less than 0.2 percent would create economic damages equivalent to 37.3 percent of one year's GDP. If policymakers

instead prioritized the economy and attempted to limit economic damages to less than 10 percent of one year's GDP, they would have to put up with a 1 percent mortality rate within the adult population.

When the researchers allow the degree of lockdown to vary by age group, they find that the policy that balances economic costs and mortality gains starts out with those under 65 facing a less stringent lockdown and returning to work more rapidly than in the



uniform lockdown case. The oldest group, in contrast, remains under complete lockdown until the arrival of a vaccine. Such targeted lockdown policies improve public policy trade-offs considerably. For example, adult mortality could now be kept to less than 0.2 percent with economic damages of 24.8 percent, or economic damages of no more than 10 percent are now consistent with a mortality rate of 0.48 percent.

The researchers find that for their calibration of the difference between the young and the middle-aged, both the economic and

mortality benefits of allowing even looser restrictions on the youngest (under-45) group, relative to the 45–64 group, are very small. They also find the reduction in the economic cost of a lockdown that comes from the shift from a uniform to a targeted lockdown remains in the presence of other mitigation measures, such as testing. Reducing interactions between seniors and the younger groups, for example through tight restrictions on who can enter nursing homes and segregated hours for shopping at grocery stores and pharmacies, could further reduce the eco-

nomical cost of pandemic response.

The researchers caution that their calculations do not take account of many real-world variables and uncertainties, such as economic heterogeneity and factors besides age that affect vulnerability to the virus. But they find broad support for the conclusion that, compared with uniform policies, risk-targeted responses are likely to entail lower economic costs for a given level of reduction in pandemic-induced mortality or could save many lives for a given level of economic damage.

— Steve Maas

## The Challenge of Measuring Inflation in Pharmaceutical Prices

From 2012 to 2017, the average rebate as a share of prescription drug list prices rose from 32 to 48 percent, according to analysis of novel data on drug sales by [Pragya Kakani](#), [Michael Chernew](#), and [Amitabh Chandra](#). In **Rebates in the Pharmaceutical Industry: Evidence from Medicines Sold in Retail Pharmacies in the US** (NBER Working Paper 26846), they conclude that by focusing on list prices, indices of prescription drug costs may significantly overstate the actual inflation rate.

A rebate is the difference between the list price of a drug and purchase prices negotiated between insurers or pharmaceutical benefit managers and the drug's maker. A simple example illustrates the potential importance of a drug's rebate rate. If a drug with a list price of \$10 and a rebate rate of 25 percent doubles its list price to \$20, while the rebate rate rises to 50 percent, the list price increases by 100 percent, while the net of the rebate price increases by only 33 percent, from \$7.50 to \$10.

The researchers attribute the growth in rebates almost entirely to rising rebates for the same drugs, rather than shifts in market share to drugs carrying larger rebates. When shifts

in market share did occur, they were toward new, more effective drugs that commanded higher net prices. Without such shifts, average annual rebate growth would have been 4.8 percent rather than 3.2 percent.

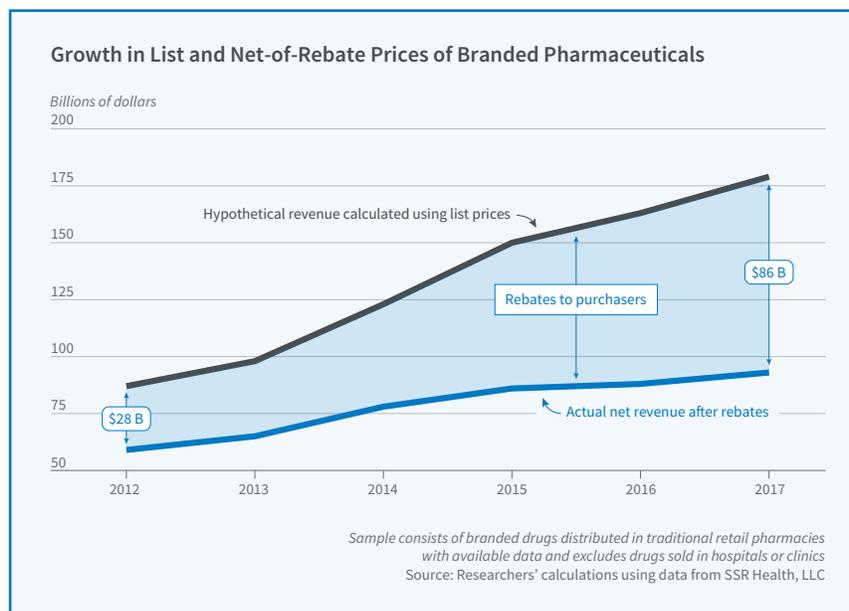
Ignoring price rebates negotiated by insurance companies and benefits managers may significantly overstate estimates of drug price inflation.

With access to closely held rebate data, the researchers used a sample of branded drugs sold by retail pharmacies, excluding those dispensed in clinical settings. Net prices were based on average payments across market segments: commercial, Medicare, and Medicaid. They did not have access to specific rebate data.

Aggregating all price data, the researchers estimate that list prices rose by a compound annual rate of 12 percent between 2012 and 2017, while net prices rose by only 3 percent. Drilling down, they analyzed pricing trends for

different drug categories. They found important disparities across drug classes. For example, between 2012 and 2017, list prices for insulin rose at an annual rate of 16 percent, while net prices rose by only 2 percent a year. In contrast, for hepatitis C treatments, between 2012 and 2014, net prices rose on average 88 percent per year, while list prices rose 62 percent, as a result of the introduction of the powerful drug Sovaldi. From 2014 to 2017, however, with the entry of additional hepatitis C therapies, the trend reversed and net prices fell while list prices remained stable.

Recognizing the role of rebates also requires revision of conventional wisdom about the share of the growth in pharmaceutical company revenue that is driven by increases in the price of drugs already on the market versus the entry



of new products. As measured by list prices, hikes in the cost of existing drugs accounted for 76 percent of revenue growth. However, after accounting for rebates, revenue from existing drugs explained just 31 percent of growth.

Rebates have had an uneven impact on consumers. Assuming robust competition among insurers and pharmaceutical benefits managers, consumers could receive much of

the savings in the form of lower premiums and co-pays. However, where competition is imperfect, benefit managers or insurers could retain a greater share of the rebates.

The rise in rebates does not help the uninsured, who have no one to negotiate on their behalf and who may therefore pay list prices, or insured consumers on expensive medication, who may face higher out-of-

pocket costs in connection with coinsurance payments that are pegged to list prices rather than to net-of-rebate prices. “Thus, while insured patients with fewer health needs may benefit from lower premiums associated with rebates,” the researchers conclude, “sicker or uninsured patients may be worse off and may forgo valuable drugs.”

— Steve Maas

## Why Does the Federal Reserve React to Market Downturns?

The “Fed put” is the expectation on the part of many investors that if financial markets decline sharply, the Federal Reserve will intervene and ease policy. The basis for this belief can be found in the history of monetary policy easing following many recent market downturns, including those associated with the 1998 collapse of the hedge fund Long-Term Capital Management, the 2001 tech bubble bust, the 2008 financial crisis, and most recently the 2020 COVID-19 pandemic.

In **The Economics of the Fed Put** (NBER Working Paper 26894), [Anna Cieslak](#) and [Annette Vissing-Jorgensen](#) provide new evidence on the Fed’s reaction to market declines in the last 25 years, and explore what accounts for that reaction. Since 1994, a 10 percent stock market decline has predicted a 32 basis point reduction in the federal funds rate at the next Federal Open Market Committee (FOMC) meeting, and a 127 basis point decrease after one year. The effect of stock market returns on the federal funds rate is asymmetric. While market declines predict rate cuts, market advances do not predict rate increases.

The Fed might respond to declines in the stock market because such price movements are an important source of information on what market participants expect about the future path of economic activity, potentially corroborating or conflict-

ing with the analysis by Federal Reserve staff, or because the drop in market values may directly affect future economic activity.

The researchers document a tight link between the stock market and the Fed’s growth

Fed’s growth expectations updates than any of the 38 macroeconomic indicators available in the Bloomberg economic calendar.

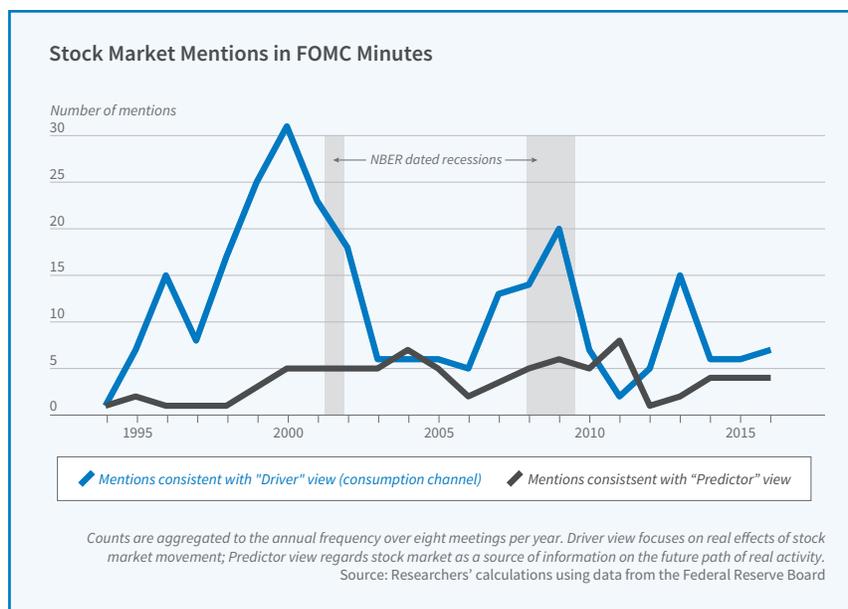
Textual analysis of the minutes of FOMC meetings from 1994 through 2016 and of

Since the mid-1990s, negative stock returns comove with downgrades to the Fed’s growth expectations and predict policy accommodations.

expectations. While the Fed’s internal measures of expected economic growth had essentially no relationship to stock returns before 1994, since then lagged stock market returns explain 38 percent of the variation in growth expectations updates. A 10 percent stock market decline is associated with a growth expectations downgrade of about 1 percentage point for the next year. The researchers find that stock market returns between FOMC meetings have stronger explanatory power for the

meeting transcripts through 2013 provides insights on whether the stock market is viewed as driving the economy or simply predicting it. Around 80 percent of FOMC participants’ mentions of the stock market in the minutes discussed it as one of the factors driving the economy. Mentions of the stock market as a predictor of future economic developments such as growth or unemployment, and discussions of stock market determinants, were more likely to be attributed to staff than to meeting

participants. Of the mentions that refer explicitly to stock market effects on consumption, 213 out of 257 refer to the wealth effect. For business investment, 9 of the 21 mentions are concerned with the effect of the stock market on the cost of capital. Results from the FOMC transcripts are broadly similar to those from the minutes, although they show more discussion of the determinants of stock market movements. These findings broadly suggest that the FOMC participants were focused more



on the direct links between the stock market and future economic growth than on the stock market's role in offering additional information about the economic outlook. On average, an additional 2.6 negative stock market mentions in the current or past FOMC meeting minutes (a one standard deviation increase) was associ-

ated with a cumulative reduction of 32 basis points in the federal funds rate.

While the FOMC discussions show a clear awareness of the potential moral hazard effects of loose policy following a crisis, these concerns do not appear to have had a major impact on policy choices. The researchers also

conclude that adjustments of the Fed's expectations about future economic growth following stock market declines were roughly in line with the adjustment of the expectations of the Survey of Professional Forecasters and the Blue Chip Economic Indicators Survey.

—Linda Gorman

## Use-Based Heating Pricing Yields Consumer and Social Benefits

Adopting use-based pricing for household heating in developing countries can save energy, benefit consumers, and help the environment. That's what happened in Tianjin, China, when authorities replaced a fixed-priced system of charges for heating with a metered, use-based system of charging for each housing unit. Four years after installation of the meters, heating demand was down by about a third.

Results of the study **Reforming Inefficient Energy Pricing: Evidence from China** (NBER Working Paper 26853) by Koichiro Ito and Shuang Zhang suggest that energy price reform can improve allocative efficiency and air quality in countries where inefficient pricing is ubiquitous.

Tianjin, in China's northeast, rolled out the use-based pricing system between 2008 and 2016. Household meters were installed long before residents started paying under the new pricing system. That allowed the researchers to identify a set of 3,874 local households for which they could measure heat usage for at least a year under the old system and compare it with four years under the new system.

Under the old system, a household of 100 square meters paid \$397 each winter for heat, no matter how much heat was used. Under the new system, the household paid a reduced fixed charge of \$198.50 plus a variable charge based on actual usage. For example, if the annual usage was 10,000

kWh of heating, the variable charge for this household was \$140, resulting in the total payment of \$338.50, which implies an annual saving of about \$60. Notwithstanding concerns that two-tiered pricing might confuse consumers and make it hard to realize efficien-

adopted the new pricing—70 percent of households—and some units—30 percent of households—that received the meters but chose to remain on the fixed-price system. Among those who adopted the new pricing system the decline in energy use was

Residents of Tianjin, China, who opted to shift from flat-rate to metered, use-based heating pricing saved money and conserved heat. All residents benefited from related reductions in air pollution.

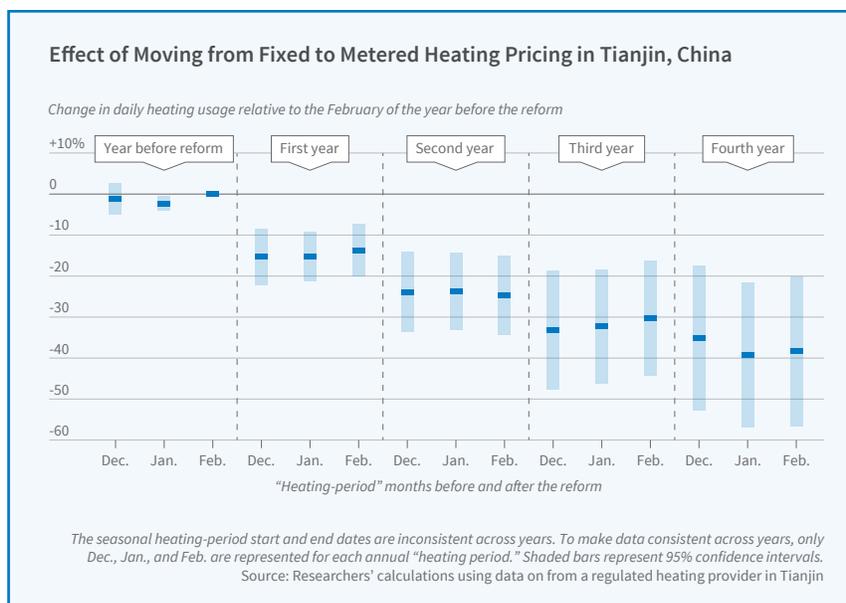
cies, the researchers find that most consumers understand the difference in pricing schemes and make beneficial choices.

By turning down the thermostat on warmer winter days, consumers saved even more. The researchers found that the average unit with the new meters used 13 percent less energy the first year, 21 percent less in the second year, 27 percent less in the third year, and 31 percent less in the fourth year. These averages include units that

even more pronounced: 36.3 percent by the fourth year. Consumers, especially relatively poorer people, learned over time when and how much to turn down the thermostat. In contrast, richer households' heating demand did not change much after the first-year drop.

Nevertheless, the rich saved more from the reform than the poor, because under the old system the fixed charge was proportional to households' floor space and richer households tend to live in larger units. Under that allocation of charges, the fixed costs of low-income households were partly subsidized by better-off households.

In addition to the cost saving for consumers, there were social benefits of lowering heating demand. The researchers estimate that the welfare gains from improvements in economic efficiency and reductions in air pollution were worth an additional \$61.29 per household per year, on average. Since Tianjin paid a one-time charge of \$99.22 per



household to install the meters, this investment was recouped in just 18 months, the researchers calculate.

The study provides direct evidence of how consumers in developing nations respond to energy pricing. That's key, the researchers

argue, because most of the world's future emissions will come from these nations.

—*Laurent Belsie*

## Results of Texas's Experiment in Increasing College Diversity

Selective college admissions are fundamentally a question of tradeoffs: given capacity, admitting one student means rejecting another. However, despite numerous changes in admissions policies, including changes in the ability of states to use affirmative action in admissions, a key unresolved question is how changes in admissions policies affect the students who gain or lose spots at particular universities as a result.

In **Winners and Losers? The Effect of Gaining and Losing Access to Selective Colleges on Education and Labor Market Outcomes** (NBER Working Paper 26821), [Sandra E. Black](#), [Jeffrey T. Denning](#), and [Jesse Rothstein](#) explore the effects of attending an elite institution on both those who are newly admitted and those who are pushed out by the introduction of the Texas Top 10 Percent rule.

In 1997, Texas established the Texas Top 10 Percent (TTP) rule after the state's affirmative action program was struck down by a court ruling. Under the rule, any Texas students in the top 10 percent of their high school class were guaranteed admission to any of the state's public universities, including the University of Texas at Austin, the system's prestigious flagship. The researchers analyze how this policy change affected educational and labor market outcomes for two different groups of students that graduated from high school between 1998 and 2002: those "pulled in" to UT Austin by the policy—students who could attend UT Austin as a result of the policy, but would not have been likely to do so in the absence of the policy—and those "pushed out"—students who were not admitted but could have been before TTP.

The researchers first compared the demographics of the two groups. Proponents of TTP suggested that the pulled-in group would consist of high-performing students from schools that historically had not sent

Texas's Top 10 Percent rule raised college attendance, graduation, and earnings for students from underrepresented high schools who gained access to UT Austin but did not reduce these metrics for those who were crowded out.

many graduates to UT Austin. Indeed, the pulled-in students had higher test scores and had taken more AP classes than pushed out ones. The pulled-in group also was more racially diverse and from lower-performing schools with higher shares of minority and low-income students.

The TTP rule had meaningful positive effects on pulled-in students, who were

about 3.7 percentage points more likely to graduate from a four-year college in Texas, and were 3.9 percentage points more likely to graduate from UT Austin. Pulled-in students also enjoyed higher earnings 9 to

11 years after high school graduation. The researchers conclude that their results "are... consistent with well-prepared students from poorer high schools benefiting from attending higher quality colleges."

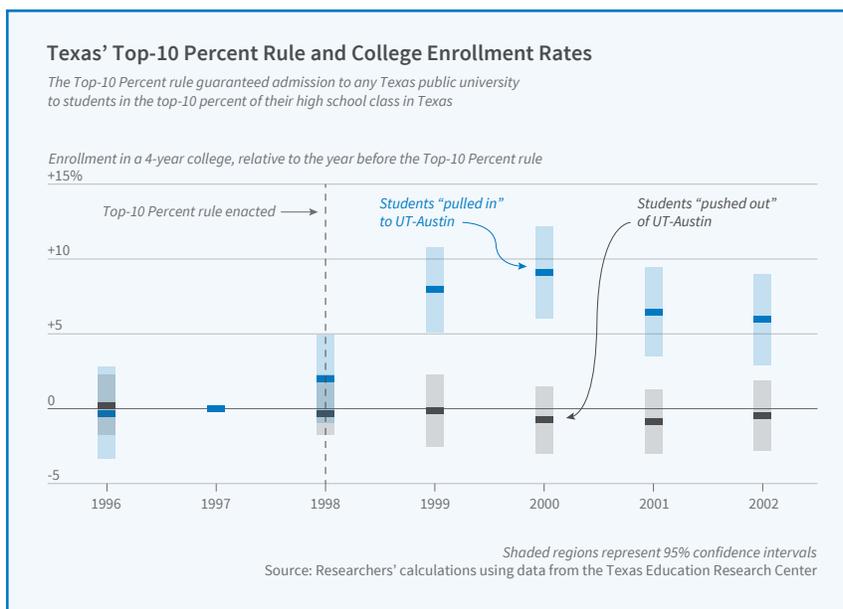
Among pushed-out students, the TTP change resulted in a 3.7 percentage point decline in the likelihood of attending UT Austin and an increased likelihood of attend-

ing another four-year school or community college in Texas. The policy did not lead to significant changes in overall college enrollment rates for these students, although they attended less selective schools as a result of the TTP rule. This did not appear to significantly reduce either four-year college graduation rates or earnings nearly a decade after graduation for these students.

The researchers conclude that their "results are consistent with col-

lege selectivity mattering for students from disadvantaged schools but not mattering for students from more advantaged schools... These different effects may be driven by peers, mentors, or parents who can help insulate students displaced from selective institutions."

—*Dwyer Gunn*



about 6.6 percentage points more likely to attend a public four-year college in the state and 5.3 percentage points more likely to attend UT Austin after TTP came into force. These students attended better colleges in general, as measured by average graduation rates and peer quality; they were

# Environmental Preferences, Competition, and Firms' R&D Choices

Consumers' environmental preferences, in conjunction with the level of market competition, affect firms' decisions to invest in environmentally friendly innovations, according to findings reported in **Environmental Preferences and Technological Choices: Is Market Competition Clean or Dirty?** (NBER Working Paper 26921), a study by Philippe Aghion, Roland Bénabou, Ralf Martin, and Alexandra Roulet.

The researchers hypothesize that consumers care about the environmental footprint of products they buy, and that firms consider these preferences when choosing how much to invest in research and development on "clean" or "dirty" innovations. They then use data on patents, consumers' environmental preferences, and product-competition levels in the automotive industry for over 8,500 firms in 42 countries between 1998 and 2012 to evaluate how companies respond to changing consumer sentiments.

They find that firms catering to more environmentally focused consumers, measured as a weighted average of support for pro-environment positions in the markets in which the firms sell their products, appear to reallocate their resources toward developing sustainable technologies. The share of dirty-technology patents

declines for these firms. They also find that the relationship between consumer preferences and firms' investments in clean technology is stronger in markets defined by higher levels of competition.

Firms in automobile-related businesses whose consumers are environmentally focused are more inclined to develop sustainable technologies, particularly in markets defined by higher levels of competition.

The researchers note that the link between competition and green investment is *a priori* ambiguous. High levels of competition could result in less environmentally friendly practices if firms attempt to keep prices low, but they could also incentivize companies to invest in green technology as a means of differentiating their products. Both effects may be present; the researchers find

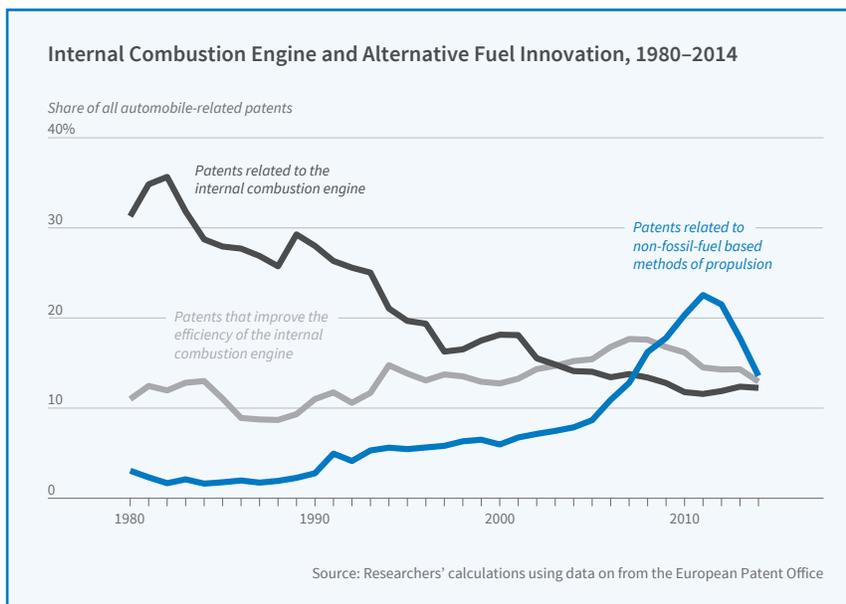
that the latter effect prevails.

For firms exposed to more sustainability minded consumers, the growth rate of clean patents is 14 percent higher than the growth rate for dirty patents; that difference jumps to

17 percent in more competitive markets. To put these numbers in context, the researchers compare the effects to the impact of a significant hike in fuel prices. They find that realistic increases in environmentally friendly attitudes and product competition—shifts on par with historical trends—would have the same impact on firms' investments in clean technology as a 40 percent jump in fuel prices.

The findings suggest that consumer preferences for different types of products can have a meaningful impact on firms' R&D decisions under some conditions. While each individual consumer's choice to "buy green" may not have a large effect on pollution, an environmentally focused consumer class can alter firms' willingness to invest in R&D directed toward environmentally friendly products, particularly in competitive markets.

—Dwyer Gunn



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